Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 11, 2020

# STOCK PRICE PREDICTION USING ARTIFICIAL NEURAL NETWORKS

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***Received: 12.04.2020*** ***Revised: 19.05.2020*** ***Accepted: 10.06.2020***

**Abstract**

Prediction and analyses of the stock market data is playing a significant role in today's economy. The process in the stock market is obviously with lot of uncertainty so it is highly affected by lot many factors. This became an important endeavourin business and finance. There are many types of algorithms that are used for predicting/forecasting. They are normally categorized into two types. One is linear model and the other one is non-linear model. Auto Regression [AR], Auto Regression moving Average [ARMA], Auto Regression Integrated Moving Average [ARIMA] are categorised as linear models. Neural Networks are non-linear models. Artificial Neural Networks and deep learning are the most dominant tools for computer vision. Such techniques are useful in learning complex forms of data by using models of supervised learning. In deep learning, whence a program is written, it will be programmed to learn slowly the process to perform intelligent tasks beyond the programming boundaries – it gradually learns through datasets and experience. Due to high volumes of data getting generated in stock markets, machines would learn differentiating patterns, thereby making reasonably good predictions. Various Deep learning models /architectures are already available for stock price prediction of a particular company.

- Recurrent Neural Networks(RNN)
- Convolutional Neural Networks(CNN)
- Multi layer Perceptron's(MP)
- Artificial Neural Networks
- Long Short-Term Memory Model(LSTM)

Based on historical prices available as data, these models are used to forecast stock prices. The field of DL is being exploited by most of the IT providers. In the current proposed project, we are using LSTM for predicting the identified stock future prices. This model is trained by giving 60 days of data of a particular company stock, Then it is possible to do predictionof61stdaystockprice.Toenhanceperformanceofmodel, different optimization techniques can be used. Optimization through RMS prop is best optimization in predicting stock price. The results obtained shows these neural networks surpass existing linear models.

**Keywords:** Artificial Neural Networks (ANN), Deep Learning (DL), Supervised Learning, RMS Prop, LSTM (Long Short Term Memory) Model, Recurrent Neural Networks (RNN), Convolutional Neural Networks (CNN), Multilayer Perceptron (MP).


DOI: http://dx.doi.org/10.31838/jcr.07.11.152

## INTRODUCTION

Stock markets tend to be extremely volatile and also create huge amounts of data on each trading day. A place where stocks or shares of listed companies are traded is stock market. It consists of two components,

1. Primary
2. Secondary.

Primary market can be defined as a place where issues are introduced newly through IPOs abbreviated as Initial public offerings, whereas in secondary market, investors will trade on derivatives / securities that are owned by them.

Stock markets follow non-linear time series containing high fluctuating data. Because of its random nature, prediction involves risks compared to other sectors.

Characteristics of ANN enabling its success are

- Even if the data is very complex, ANN is a very good function approximator.
- ANN's are capable of identifying new sample test data, even though they are not used during ramping up of models/networks.

This paper deals with Stock price prediction using Artificial Neural Networks. Section 2 deals with Literature Survey, Section 3 talks about Artificial Neural Networks, Section 4 deals with Recurrent Neural Networks, Section 5 talks about Deep Learning, Section 6 talks about Methodology, Section 7 deals about Results and Discussion and the final Section 8 concludes the paper.

## LITERATURE SURVEY

In recent times, Artificial Neural Networks (ANNs) are widely deployed in the domain of stock price prediction. Various stock market prediction models are analysed in University of Sheffield [1]. Budhani N has done the prediction of stock market using (ANNs) artificial neural network in soft computing techniques in fields of science, engineering and technology [12].

Ajith Kumar Rout has used low complex Recurrent Neural Networks (RNNs) for predicting / forecasting the stock prices. Yunus Yetis have used ANN's for predicting NASDAQ's stock price with the input given [13]. Roman has analysed the multiple stock market using RNN and back propagation algorithm [12]. Neini did a comparative study between Elman neural network and Feed Forward MLP. Mizuno used neural networks for technically analysing the prediction model[14].

In 2011, Gurusen studied about effectiveness of using ANN in the prediction of stock market [18]. X-Ding did a study on both financial Time series Analysis and Natural Language Processing [21]. In [23] LSSVM [Last Square Support Vector Machine] and an optimization technique called PSO [Particle Swarm Optimization] are used for stock market prediction. [24]Batres-Estrada focussed on numerous data learning models applications in Time-Series based analysis. Kim approached in altogether different path for stock market price prediction using Genetic algorithm by discretization of different features in ANN.

These are the different approaches done so far for predicting the most fluctuating stock market using Artificial Neural Networks.

**Artificial Neural Networks**

Artificial neural networks are basically designed to fathom complicated issues that normal machine learning algorithms or easy neural networks cannot. ANNs are connected in a simpler way that they don't do huge weightlifting of human brain which is having around 86 billion neurons, in a complex and complicated web of interconnectivity. Deep learning is considered as part of machine learning. In fact, machine learning helps in creating models that are better at assignments allotted to them. If a machine learning algorithm provides inaccurate and non-obvious results, the developers will take adequate steps to amend. Models of deep learning that uses Artificial Neural Networks simulates the working of a human brain and obviously determines accuracy of the predictions on its own, without the intervention of human brain. Artificial neural networks are capable of learning what they parse and can generalize or create patterns with the derived knowledge. Such powerful faculty is often taken for granted as human brains perform such tasks automatically. ANNs are far different from the existing traditional methods in training or precisely programming systems as they need detailed rules, which cover at the outset each possible outcome. The process of discriminating the category into which piece of data belongs to can be defined as classification task; Prominent use of this approach is in programming a neural network. Such ability in classifying live patterns or examples is generalization.

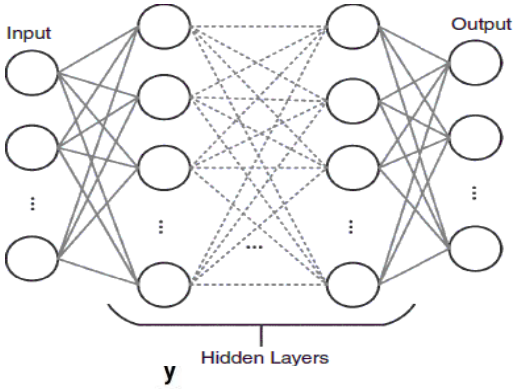


**Fig.1: Layers of Neural Network**

**Training the Network**

ANNs are much used for teaching the network. This method of teaching a network is termed as training the network. Training a network literally means, fitting a network to our training data set. This method is inspired from algebraic equations where in the process is to fit information to a mathematical model or time series line.

A training set is sample data which is assumed as sufficiently representative so that network should derive or learn from it. Network learning by the model is called task. Training of ANNs means the model is programmed to handle well the given tasks based on unforeseen scenarios. When an artificial network is insufficiently trained, it's called under fitting that implies network has not learnt that particular training set adequately.

Converse of under fitting is over fitting. A network gets learnt on training set much well and becomes ineffective when applied to newer data patterns. We identify a suitable model for particular given task through withholding some information from training process. It helps to evaluate the model during and after training. The withheld information can be of two components: validation part & training part. Information based on which our model is evaluated during training is called validation part. Though this is not used for training, it surely provides us with detailed analysis on the performance of the network in its training process.

**RECURRENT NEURAL NETWORKS**

Recurrent Neural Networks (RNNs) are not like Multi-layer Perceptron (MLP). Recurrent Neural Networks [19] takes inputs from two types of sources, one is from present and the other is from past. Information derived from such sources is to be used for modelling networks reaction to the newer sets of input data. This is possible with feedback loops wherein output at any instance can be taken as an input to its subsequent instance. This means RNN needs memory. Every input with its huge loads of data needs to be stored in some layers of RNNs. This stored data or information is recursively used in the network as it will be sweeped forward for dealing with newer example. Fig 2 depicts representation of RNN.

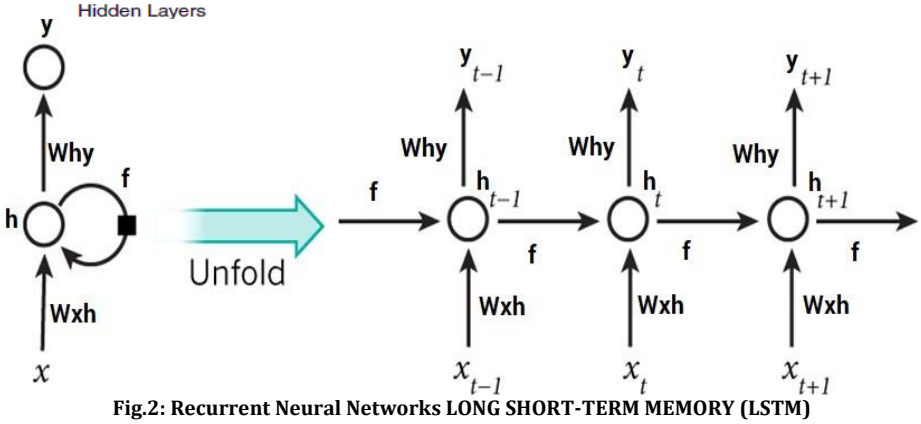


**Fig.2: Recurrent Neural Networks LONG SHORT-TERM MEMORY (LSTM)**

[18] LSTM is nothing but a prototype of Recurrent Neural Networks. Such networks are quite stronger in identifying as well as learning in longer term dependencies. This model was first introduced by Schmid Huber and Hoch Reiter in the year 1997. Those network models are popularly created to escape from problem of longer dependency but storing data sets or information for long period of time is characteristic. LSTM is different compared to familiar artificial neural networks or recurrent neural networks. Conventional RNN comprises a simple network along with feedback loops whereas LSTM consists of memory blocks or cells in place of a single network layer. Every cell consists of three gates as well as cell state-machine which regulate data flow through such cells.

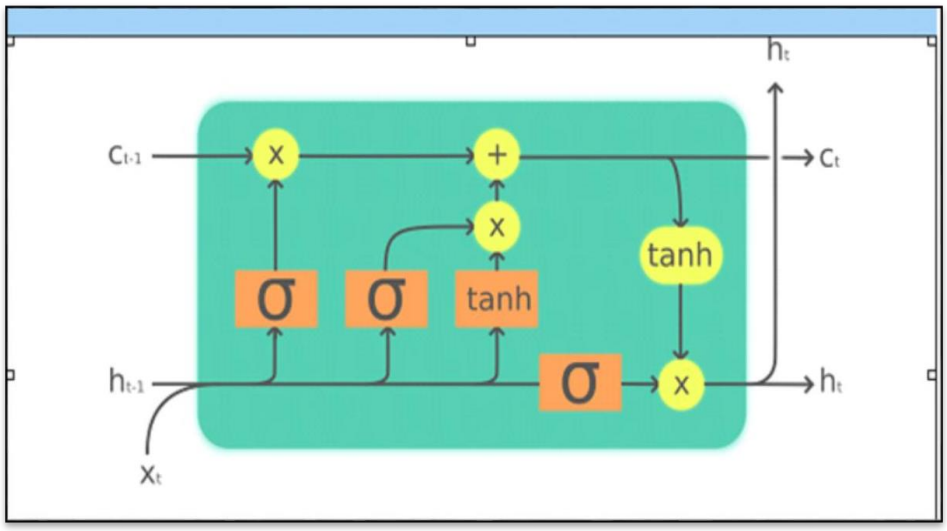


**Fig. 3: LSTM Cell**

In fig-3, horizontal line segment which is passing through upper half of picture is cell state (Ct−1 Ct). It behaves similar to conveyor belt running through a network. It is used for carrying information from instances of previous cells to subsequent cells in regular fashion. The sigmoid layer plays crucial role in deciding on storing of information in cell state. The output obtained from forget gate is then attached to cell state through bit-wise multiply operation. Subsequently, the input gate mainly consists of tanh layer along with sigmoid layer (it), which are added into the cell state. C' has values from tanh layer and Output (ht) gets created through point-wise multiplication of tan h with sigmoid gate Ot.

**Deep Learning**

In recent years, exponential progress is observed in the turf of deep learning exploration towards training of Artificial neural networks. This is possible by using an aggregate of high-availability of substantial data sets, due to corresponding rush in big data, and the entry of newer GPU-based hardware called graphics-processing-unit hardware that makes these massive data set units to be processed in practical timescales. More recently, many number of long standing problems in AI, ML and data administration have got significant improvements, significant to unshackle age-old performance blockades. Such accomplishments enthused development of augmented tools and methodologies leading to wider deployment of DL techniques. New plethora of smart automated assistants like OK Google, Alexa, etc have own proprietary learning algorithms with backgrounds secured in deep learning. Through this paper, we witness the current stage of DL and its advances, how it improved established techniques of neural networks, and more prominently on adaption of DL in our study activities with new as well as empirical data.

**METHODOLOGY**

Dataset is taken from the stock data of a particular company named Infratel. The data set contains information like previous closing, opening, high, low, volume of the stocks of that company. From these datasets, we extract only two months of data; this data will be used to train the model. Using this trained set of data, predicting the 61th day stock market price of that company can be accomplished. The intra-day closing price of stock is given preference as investors have to take decision on buying with only the stock closing value.

**RESULTS AND DISCUSSION**

**Table 1: Comparative Analysis**

| | code | doq | open | high | low | close | volume |
|---|---|---|---|---|---|---|---|
| 0 | INFRATEL | 2014-01-01 | 169.5 | 170 | 167.75 | 168.15 | 13233 |
| 1 | INFRATEL | 2014-01-02 | 166.6 | 172.3 | 166.6 | 171.5 | 98992 |
| 2 | INFRATEL | 2014-01-03 | 172 | 175.95 | 170 | 174.8 | 483177 |
| 3 | INFRATEL | 2014-01-06 | 175 | 178.7 | 170.25 | 176.05 | 1127035 |
| 4 | INFRATEL | 2014-01-07 | 176.2 | 180 | 173.85 | 174.8 | 81502 |
| 5 | INFRATEL | 2014-01-08 | 174.95 | 177.95 | 173.2 | 176.95 | 58616 |
| 6 | INFRATEL | 2014-01-09 | 175.1 | 178.15 | 175.1 | 177.2 | 52817 |
| 7 | INFRATEL | 2014-01-10 | 177.9 | 178.5 | 168.6 | 177.75 | 611082 |
| 8 | INFRATEL | 2014-01-13 | 176.05 | 178.5 | 175 | 176.4 | 22147 |
| 9 | INFRATEL | 2014-01-14 | 177.9 | 179.8 | 174 | 175.25 | 20377 |
| 10 | INFRATEL | 2014-01-15 | 172.7 | 176.9 | 172.7 | 174.9 | 2272058 |
| 11 | INFRATEL | 2014-01-16 | 176.55 | 176.55 | 170 | 172.8 | 618233 |
| 12 | INFRATEL | 2014-01-17 | 170.2 | 173.65 | 165.4 | 171.9 | 476833 |
| 13 | INFRATEL | 2014-01-20 | 166.25 | 170.45 | 166.05 | 167.6 | 62805 |
| 14 | INFRATEL | 2014-01-21 | 166.2 | 168 | 165.35 | 166.95 | 40312 |
| 15 | INFRATEL | 2014-01-22 | 165.25 | 169.5 | 164 | 165.4 | 14664 |
| 16 | INFRATEL | 2014-01-23 | 161.6 | 171.45 | 161.6 | 168.05 | 2706015 |
| 17 | INFRATEL | 2014-01-24 | 170.9 | 175.2 | 169.1 | 174.1 | 1690454 |
| 18 | INFRATEL | 2014-01-27 | 175 | 175.1 | 166 | 167.75 | 736309 |
| 19 | INFRATEL | 2014-01-28 | 168 | 173.65 | 167.5 | 171.75 | 184255 |
| 20 | INFRATEL | 2014-01-29 | 175 | 177.55 | 172.75 | 174 | 415425 |
| 21 | INFRATEL | 2014-01-30 | 173 | 173.1 | 168.5 | 171.25 | 178340 |

In this project, 400days of data has been taken for prediction using neural network and ARIMA. The reason is to parallel compare and analyse the performances of both ARIMA and Artificial neural network for a specific period of time. The results of this comparative analysis are tabulated in table1.

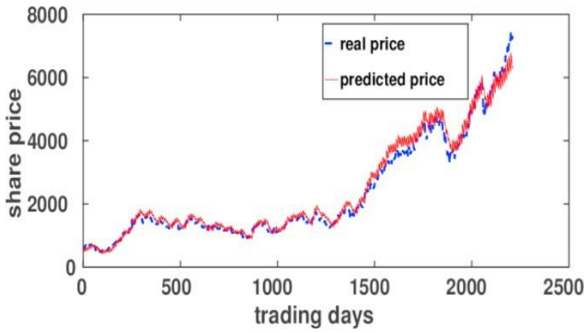


**Fig. 4: Graphical Representation of Training days with Share Price**

Here, the stock price of INFRATEL is depicted in the figure represented by table-1.Using LSTM model we can predict very close to accurate values.

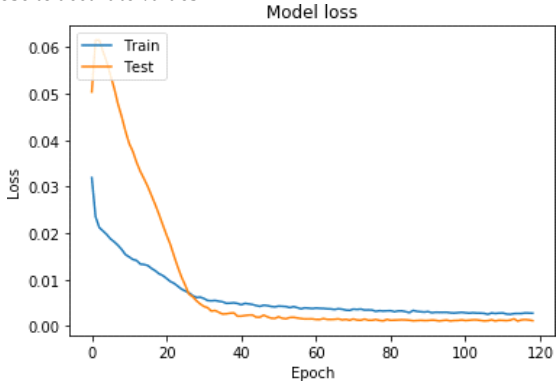


**Fig. 5: Graphical Representation showing Loss**

**CONCLUSION**

In this proposed paper, we have used deep learning model and ANN for prediction of the stock price of company INFRATEL, which is one of the leading company in the competitive world. Here we have trained four types of networks with models of LSTM. The deep learning and ANN models were utilized for prediction of stock price of the company INFRATEL.

From the above obtained results, it is quite obvious that these models are reasonably efficient in recognizing the patterns that exist in the domain of stock market. This shows that there lies an underlying dynamics, which is very common to all the stock markets. The Linear series models such as ARIMA, Auto Regression are uni-variate time-series based prediction models and they are incapable in recognizing the under laid dynamics with the help of multivariate time series. From the obtained results, we postulate that deep learning models are surpassing AR and ARIMA models. Hence from the results obtained, ANN proved as better performer when compared to other three networks. ANN is quite capable of apprehending the unanticipated and unheralded changes noticed in system since only one particular window is deployed for predicting the upcoming instance.

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